Connecting the Upper Hudson and the Western Harbor

A multi-contaminant geochemical perspective

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Acknowledgements

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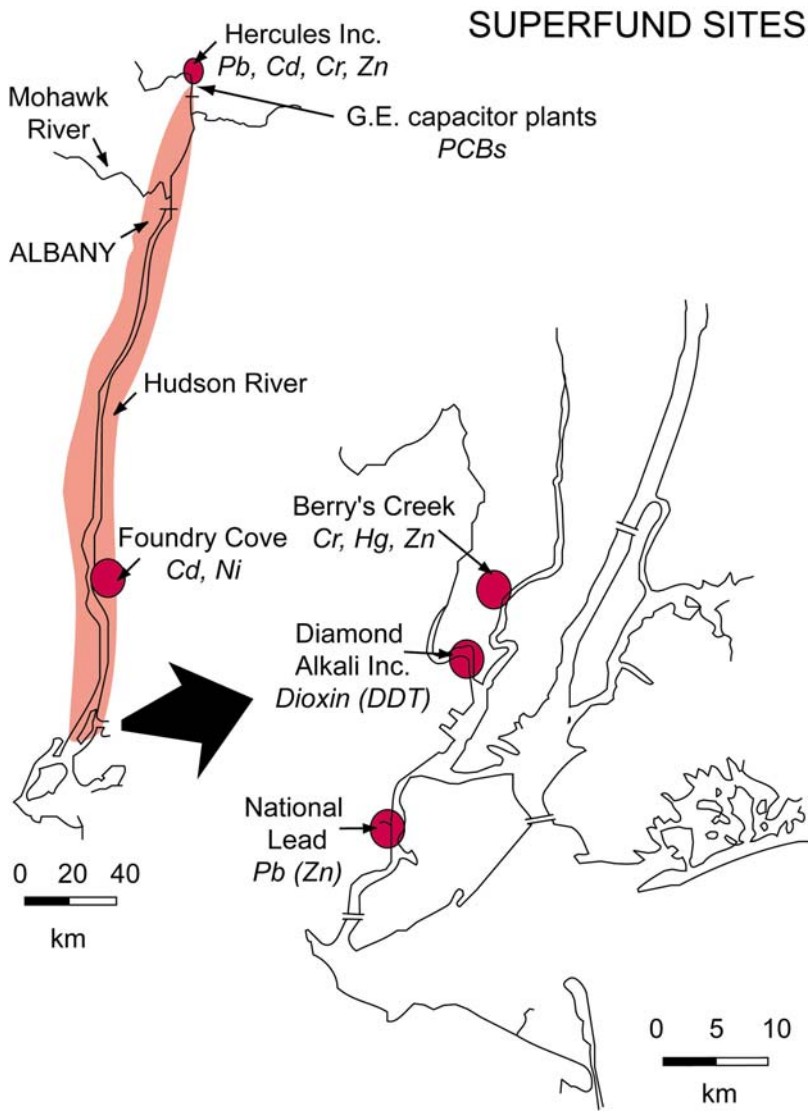
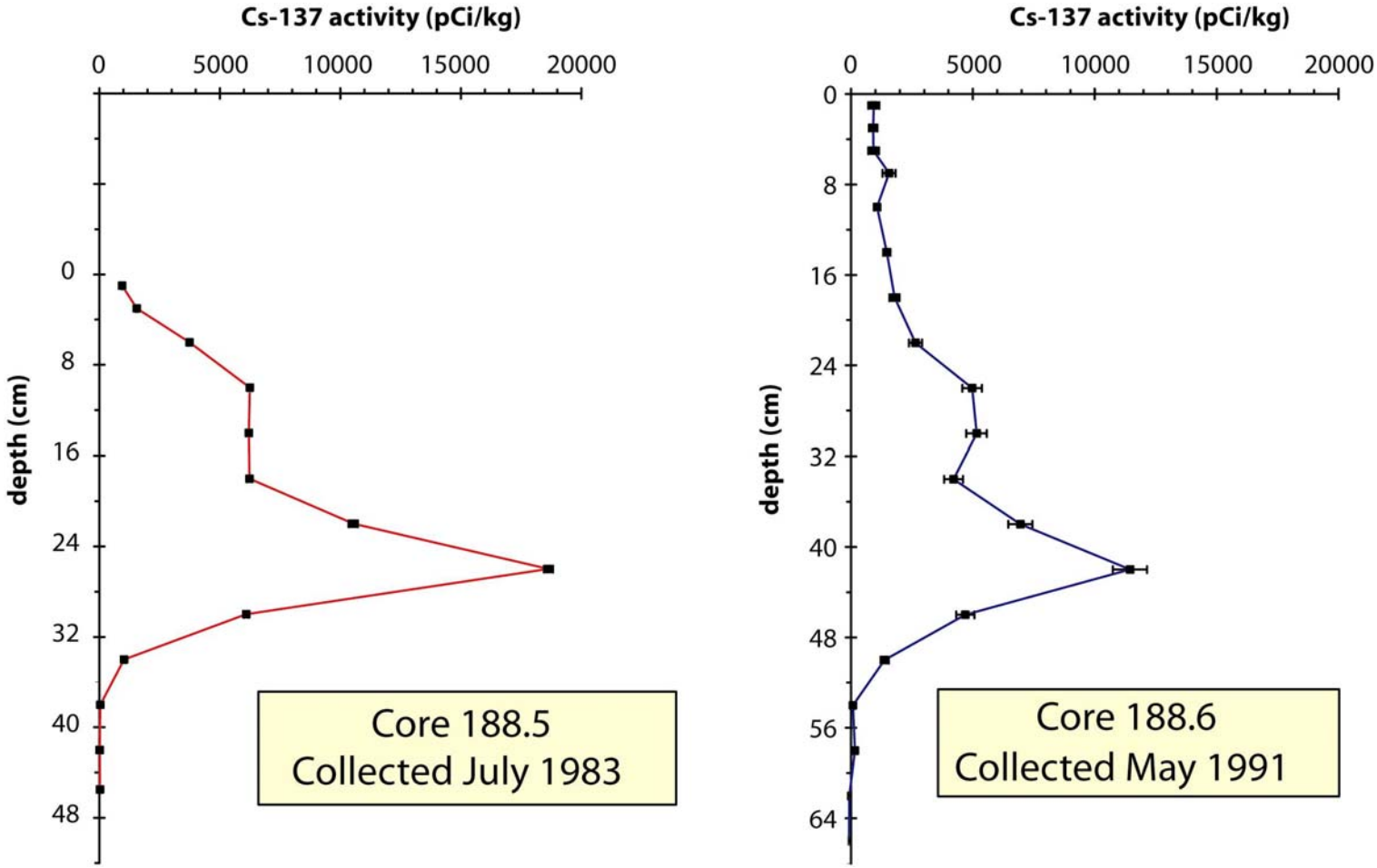
Superfund Sites in the Hudson Basin



“Near ideal” dated sediment cores



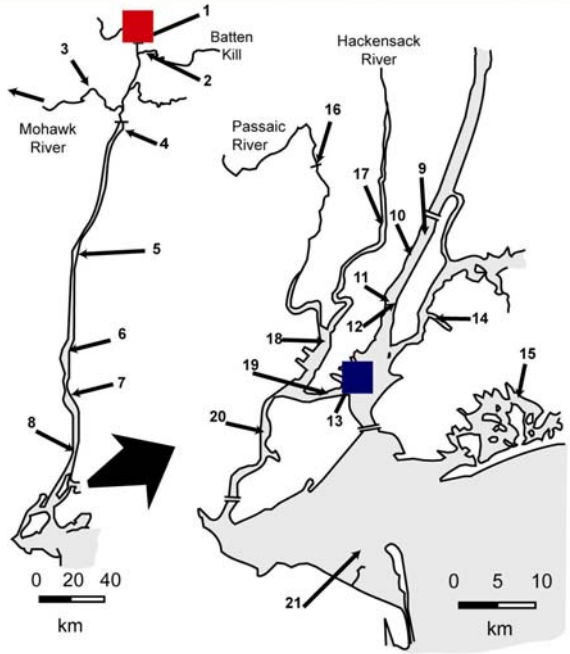
Sampling Site Information

Core Designation	Location/Significance	Use
SOURCE TRACERS		
Site 1 188.5 (1983) 188.6 (1991)	Downstream of the largest single discharger of pulp and paper waste in the Hudson basin	- PCB Chronology - Metals Chronology - Paired-Core PCB degradation studies - Dioxin time horizon samples - Characterization of of Pulp & Paper APEOs - Paired-Core APEO transformation studies
Site 2 Batt 5 (1993)	Downstream of Pulp & Paper Discharges on the Batten Kill	- Metals Chronology - Dioxin time horizon samples - Characterization of of Pulp & Paper APEOs
Site 3 Moh 7 (1993)	Downstream of Leather Tannery on the Mohawk R. (Gloversville)	- PCB time horizon samples - Metals Chronology - Dioxin time horizon samples - Cr tracer of tannery waste - Characterization of of Tannery APEOs
Site 14 Be-7 Bearing Coretops (1982, 87, 90, 92, 96, 98)	Discharge of Major Sewage Treatment Plant (Newtown Creek)	- PCB time horizon samples - Dioxin time horizon samples - DDT and chlordane time horizon samples - Characterization of Sewage-Derived APEOs
Site 15 JB 13 (1988) JB 16 (1996)	Discharge of Major Sewage Treatment Plants to Jamaica Bay	- PCB, DDT, chlordane, and metals chronologies - Dioxin time horizon samples - Characterization of Sewage-Derived APEOs - Paired-Core APEO transformation studies
Site 16 Pass 6	Downstream of Major Textile Manufacturing Center on the Passaic R. (Paterson, NJ)	- DDT and chlordane time horizon samples - Dioxin time horizon samples - Characterization of Textile APEOs
MAINSTEM HUDSON RIVER		
Site 4 152.7	Downstream of the Hudson/Mohawk Confluence	- Dioxin time horizon samples - Metals Chronology - Mixed Mohawk/Upper Hudson ' signal'
Site 5 91.8 (1977) 88.6 (1986) 88.6H (1996)	Mid-Hudson Estuary near Kingston	- PCB and DDT Chronology - Metals Chronology - Paired-Core PCB degradation studies - Dioxin time horizon samples - geographic and temporal distribution of APEO - Paired-Core APEO transformation studies
Site 6 59.55 (1992)	Lower Hudson Estuary, near Newburgh	- PCB Chronology - geographic and temporal distribution of APEO
Site 7 43.2 (1997) 43.3 (1992)	Lower Hudson Estuary, near Indian Point	- PCB Chronology - geographic and temporal distribution of APEO
Site 8 Hast 1 (1999)	Lower Hudson Estuary, near Hastings	- Currently being analyzed for PCBs in collaboration with NYSDEC (through CARP) - Mainstem Hudson Inputs to NY Harbor
Sites 9-12 Be-7 Bearing Coretops (1984, 89, 94, 96, 98)	NY Harbor, mainstem Hudson	- PCB time horizon samples - DDT and chlordane time horizon samples - Metals time horizon samples - geographic and temporal distribution of APEO
Site 13 -1.7W (1979) -1.68 (1984) Be-7 Bearing Coretops (1989, 94, 96, 98)	NY Harbor, mainstem Hudson	- PCB Chronology - DDT and chlordane chronologies - Metals chronologies - geographic and temporal distribution of APEO
WESTERN NY HARBOR/RARITAN BAY		
Site 17 Hack 14 (1987) Hack 14B (1995)	Hackensack River	- Metals Chronology - geographic and temporal distribution of APEO - Paired-Core APEO transformation studies
Site 18 NB 13 (1985) NB 20 (1986) NB 13B (1995)	Newark Bay	- Dioxin and DDT Chronology - PCB and chlordane time horizon samples - geographic and temporal distribution of APEO
Site 19 Be-7 Bearing Coretops (1985, 96, 98)	Kill Van Kull	- PCB, dioxin, DDT and chlordane time horizon samples - geographic and temporal distribution of APEO
Site 20 Kill 14 (1982) Kill 21 (1996)	Arthur Kill	- Metals Chronology - geographic and temporal distribution of APEO
Site 21 RB 17 (1981) RB 19 (1989)	Raritan Bay	- PCB and DDT chronology (unpublished data) - Dioxin time horizon samples (unpublished data) - geographic and temporal distribution of APEO

Site 1
188.5 (1983)
188.6 (1991)

Downstream of the largest single discharger of pulp and paper waste in the Hudson basin

- PCB Chronology
- Metals Chronology
- Paired-Core PCB degradation studies
- Dioxin time horizon samples
- Characterization of of Pulp & Paper APEOs
- Paired-Core APEO transformation studies

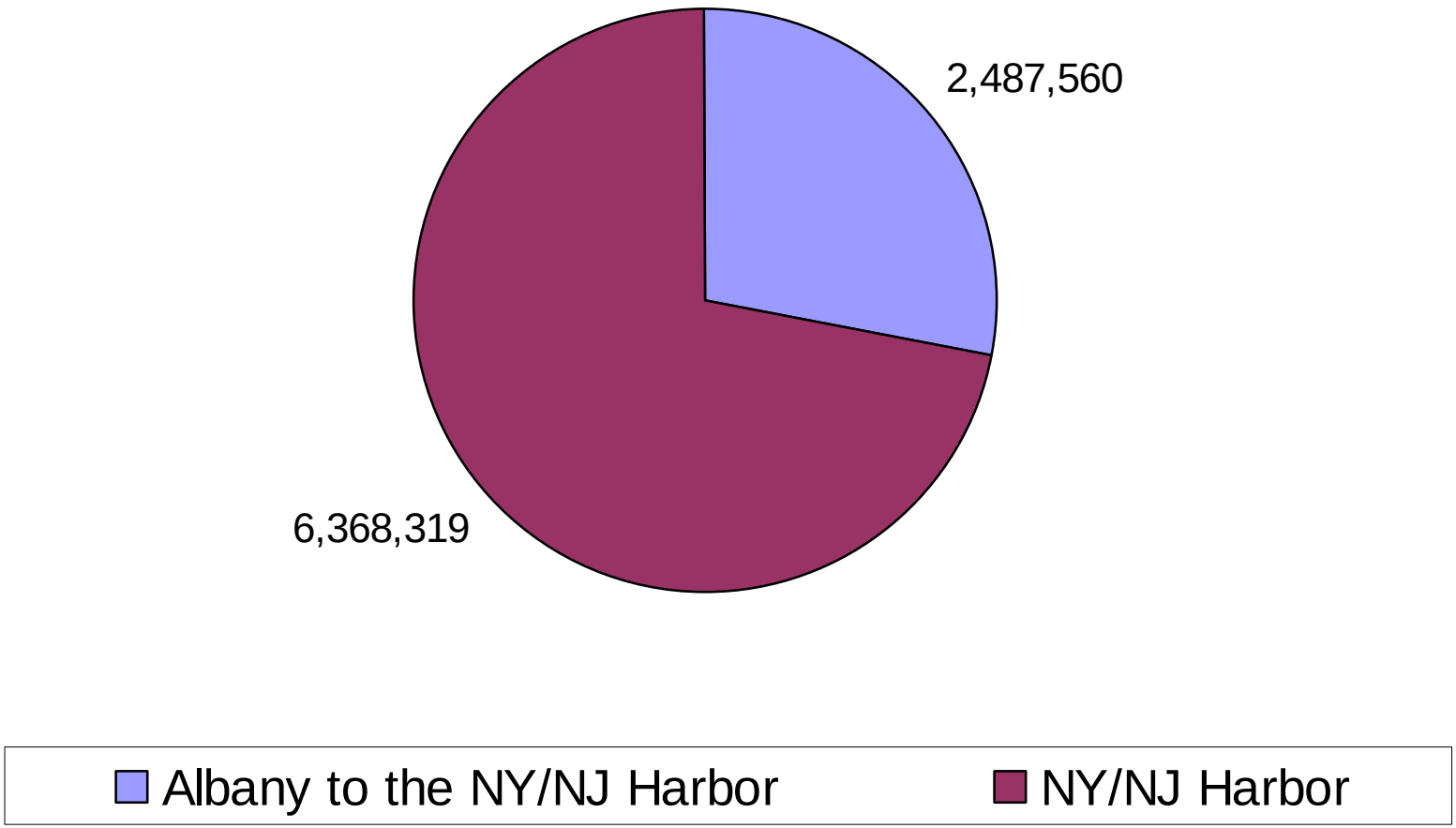


Site 13
-1.7W (1979)
-1.68 (1984)
Be-7 Bearing Coretops
(1989, 94, 96, 98)

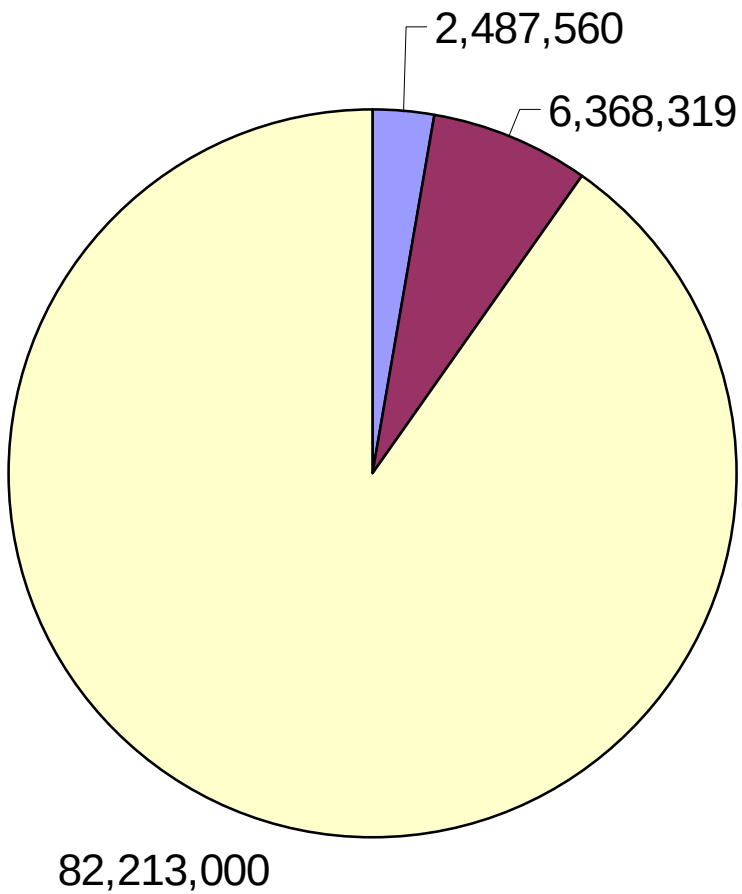
NY Harbor, mainstem Hudson

- PCB Chronology
- DDT and chlordane chronologies
- Metals chronologies
- geographic and temporal distribution of APEO

PCB Purchases (pounds) Main Stem Tidal Hudson 1958-1977

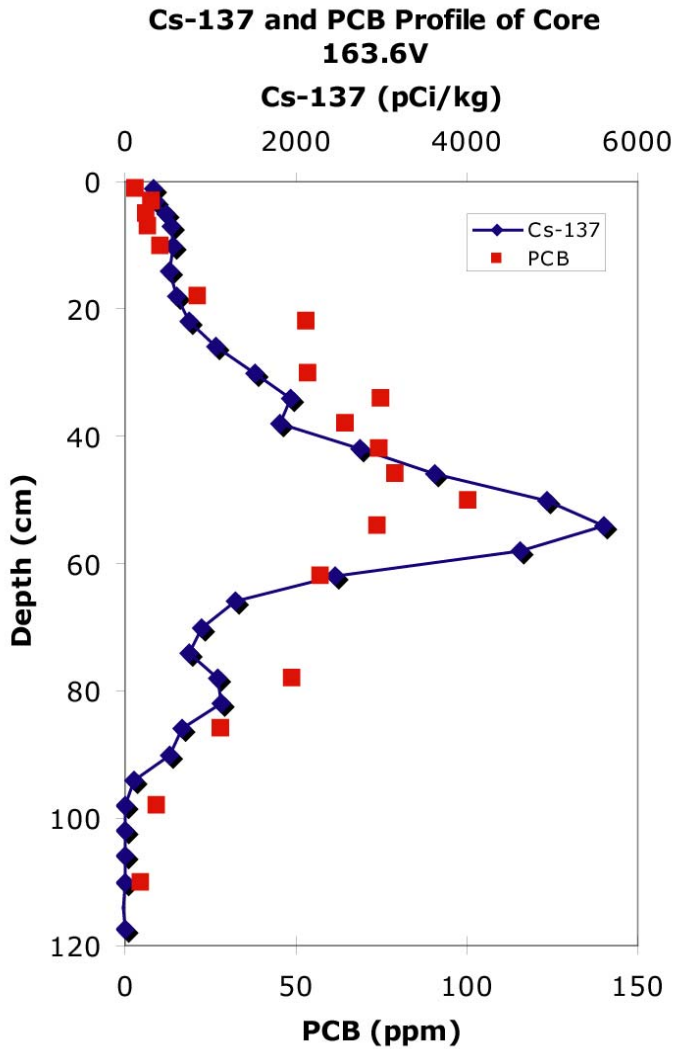


Adding in GE.....


2,487,560
6,368,319
82,213,000
Albany to the NY/NJ Harbor
NY/NJ Harbor
GE, Upper Hudson 1966-75

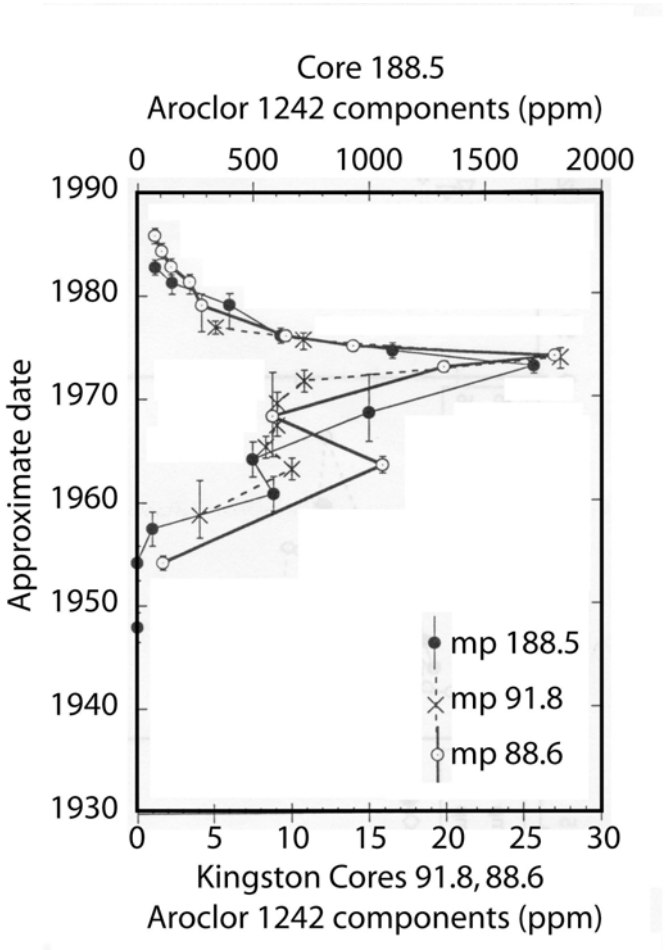
“Average” PCB levels in “recent, fine-grained” Hudson Sediments

> mp 200 and all tributaries*	<1 ppm
mp 180 to 193	a few hundred ppm
mp 157 to 166	several tens of ppm
mp 140 to 150	a few tens of ppm
mp 80 to 110	about 10 ppm
mp 40 to 60	about 5 ppm
mp 10 to -2	about 2 ppm

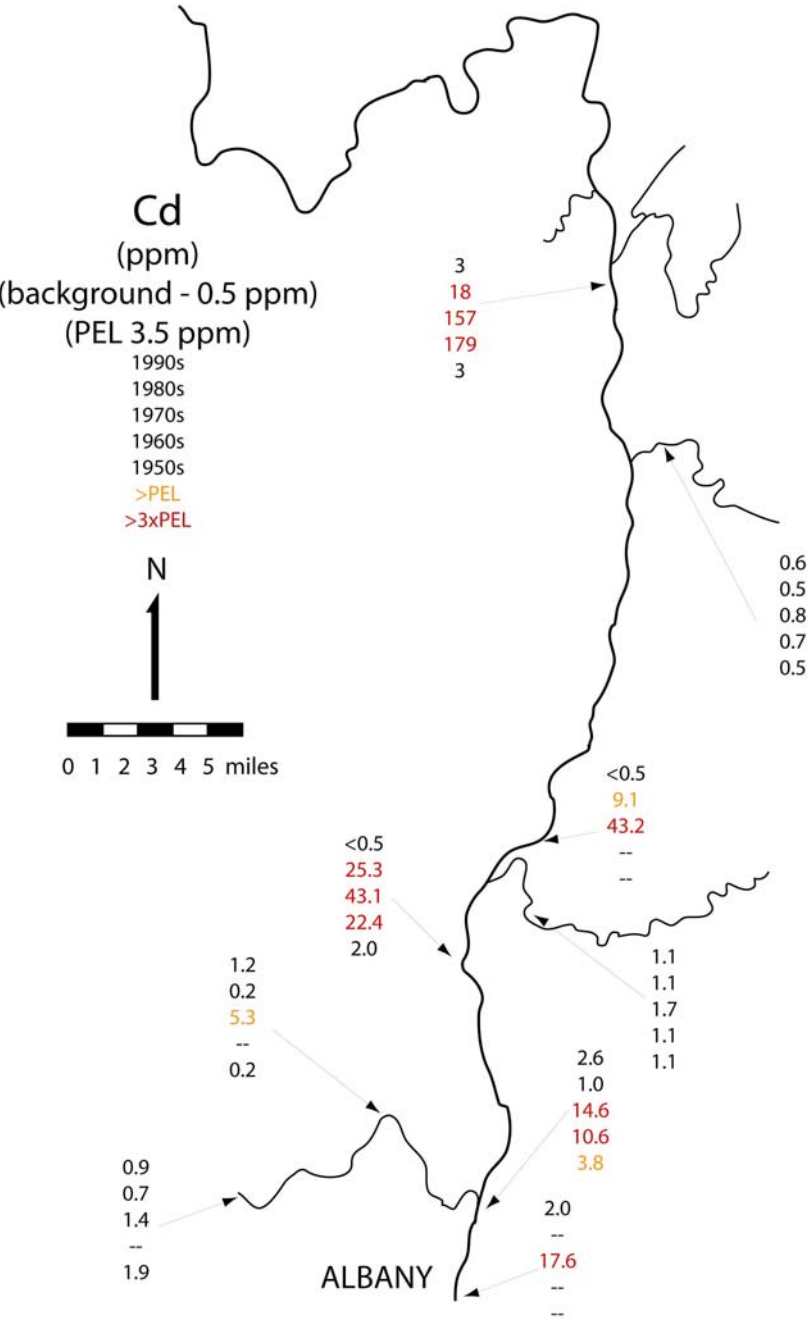


Cs-137 and PCB profile of a core from mile point 163.6.

Tracing the Upper Hudson PCB influence



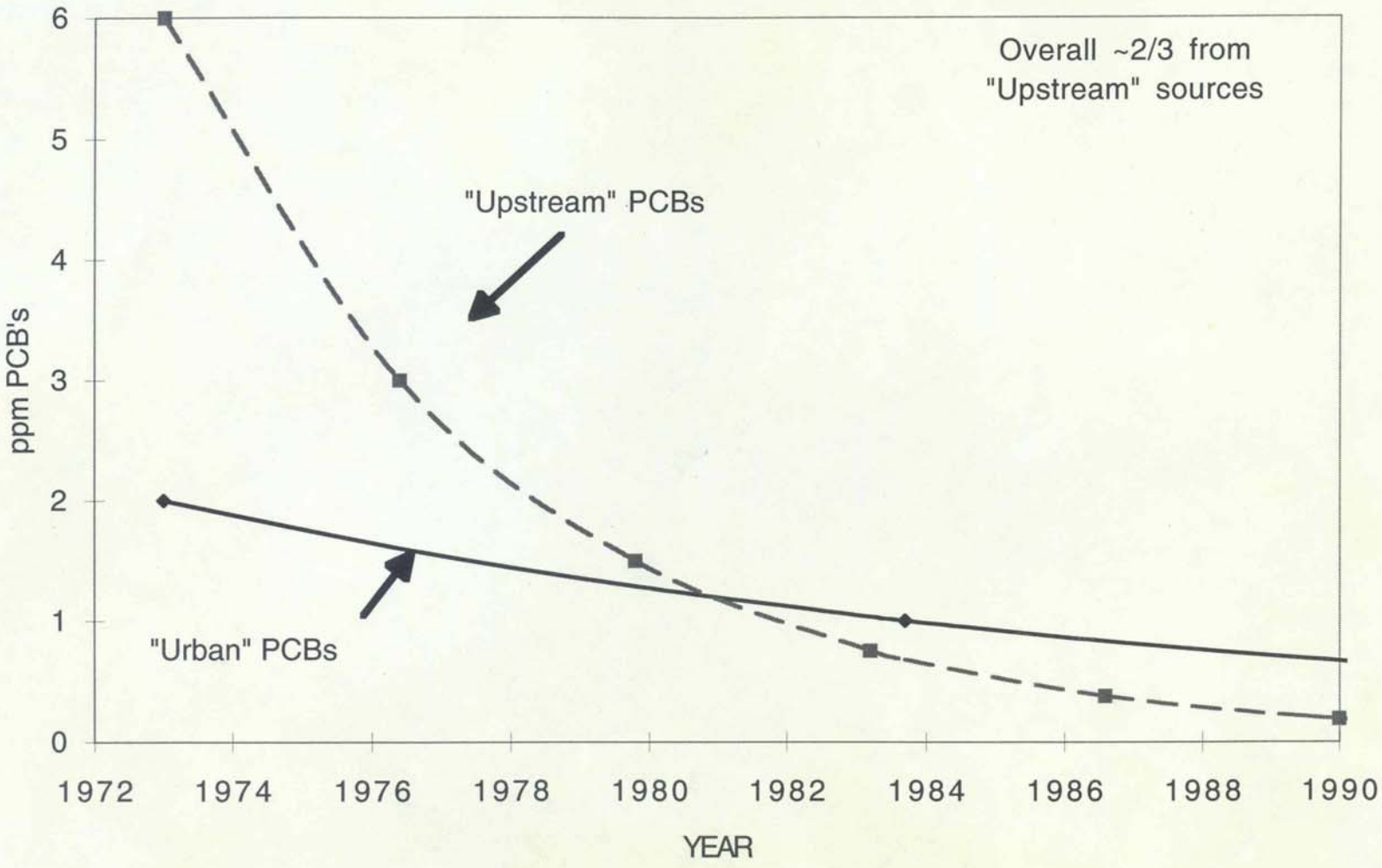
- Upper Hudson has dominated downstream historical PCB loadings

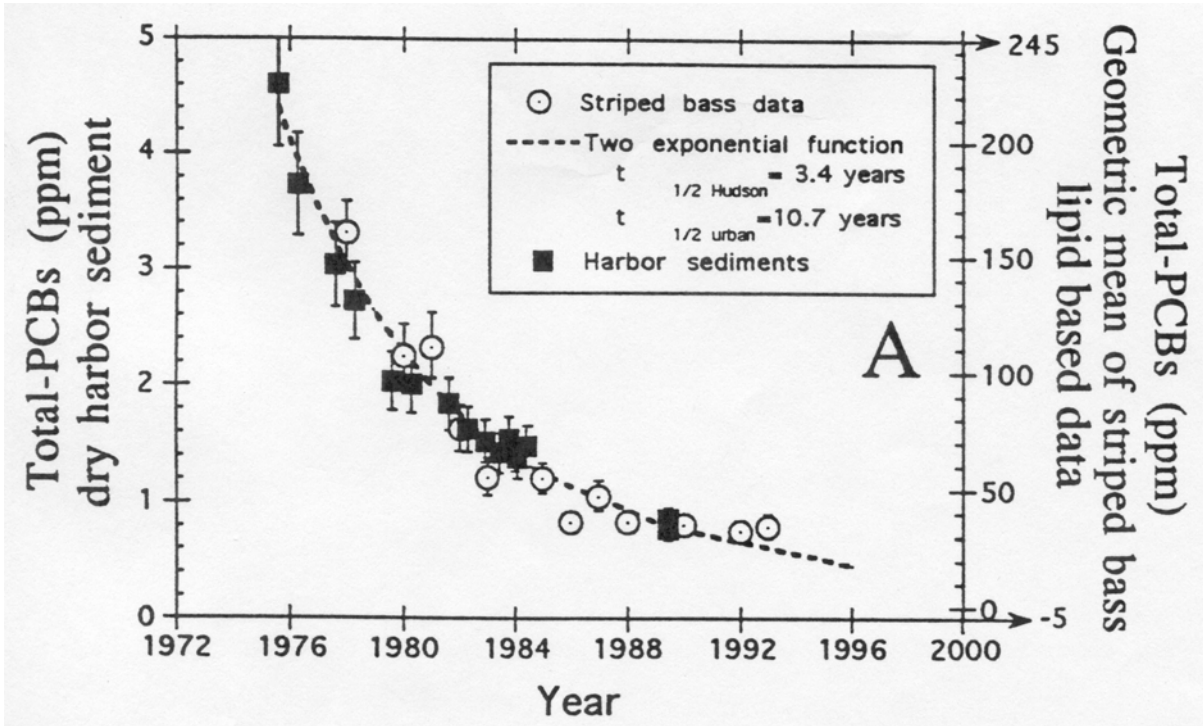


Other Particle Tracers - Metals

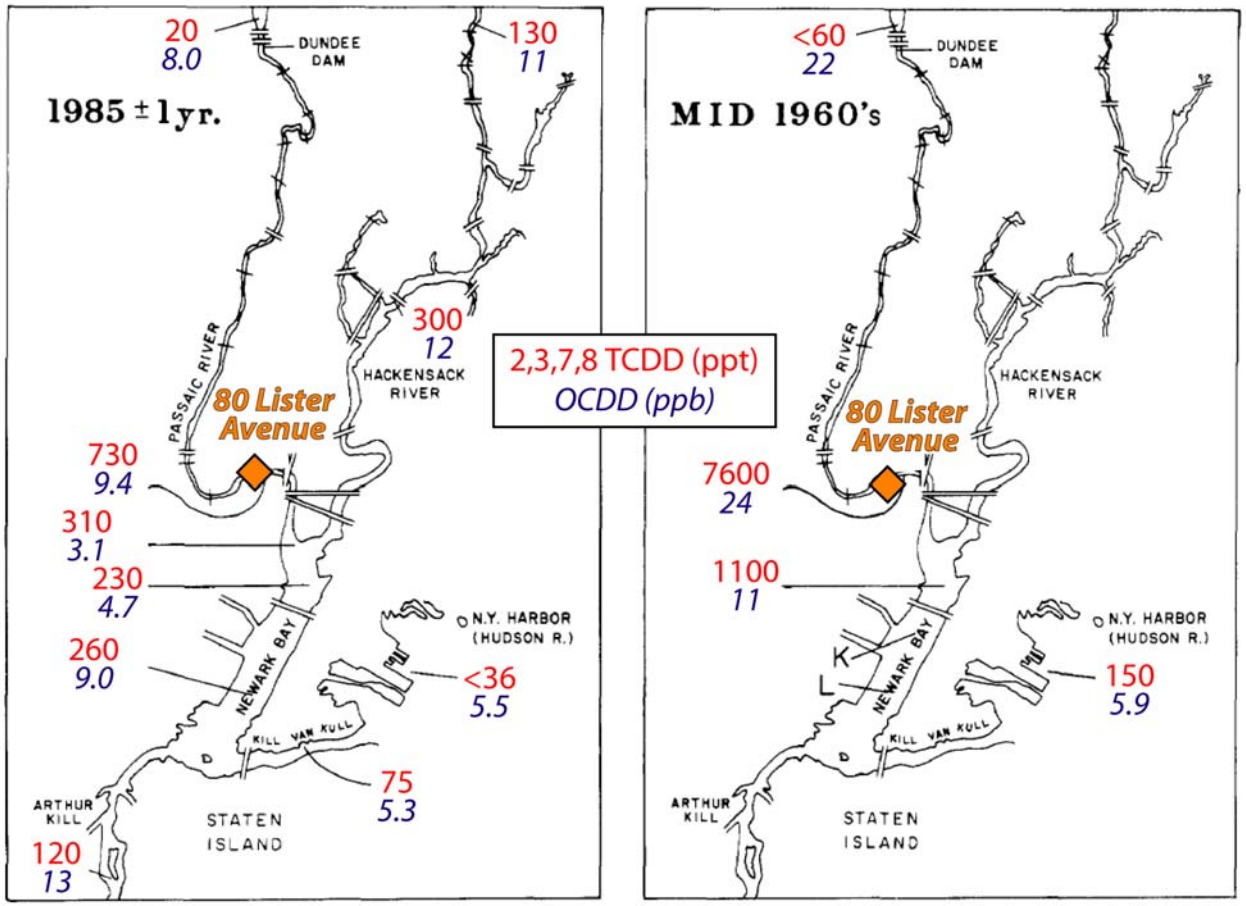
- Upper Hudson sources dominate Cd to Kingston (mp 90)
- Other metals:
  - Pb (& stable isotopes)
  - Cr
  - Hg
  - Zn

PCB SOURCES TO MAINSTEM NY HARBOR SEDIMENTS



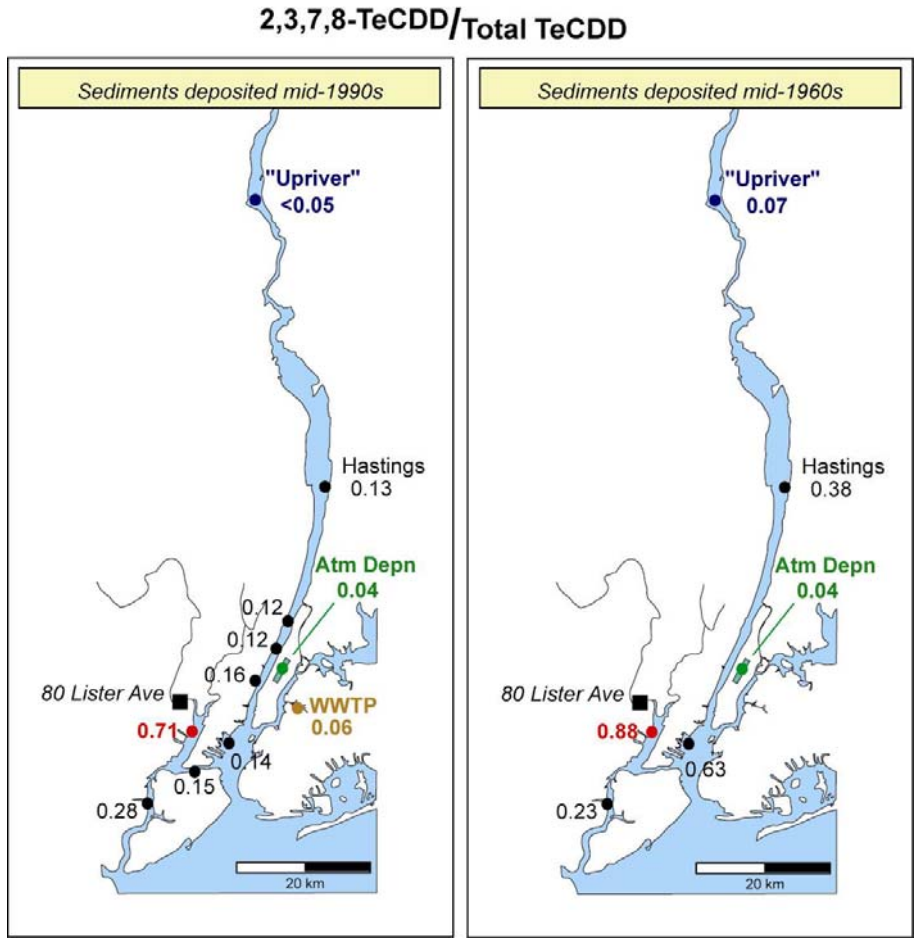

Total-PCBs (ppm)
dry harbor sediment
Total-PCBs (ppm)
Geometric mean of striped bass
lipid based data
Striped bass data
Two exponential function
t 1/2 Hudson = 3.4 years
t 1/2 urban =10.7 years
Harbor sediments
A
Year
0
1
2
3
4
5
-5
50
100
150
200
245
1972
1976
1980
1984
1988
1992
1996
2000

The “other” Superfund site – dioxins from 80 Lister Avenue

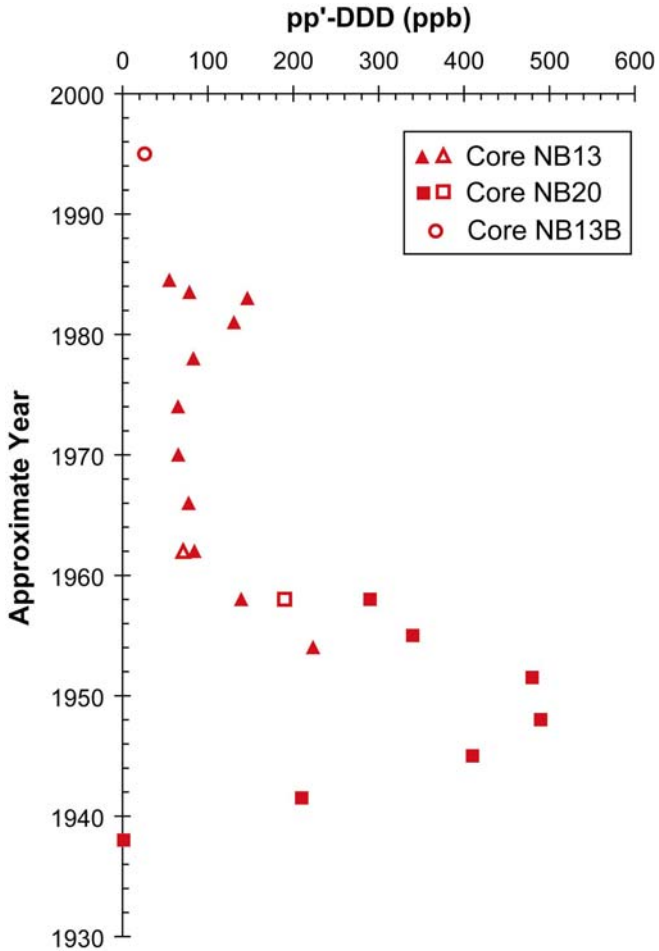


Bopp, *et al.* (1991) *Environ. Sci. Tech.* 25(5):951-956

Tracing Harbor Sources Upstream: 2,3,7,8-TCDD Ratio

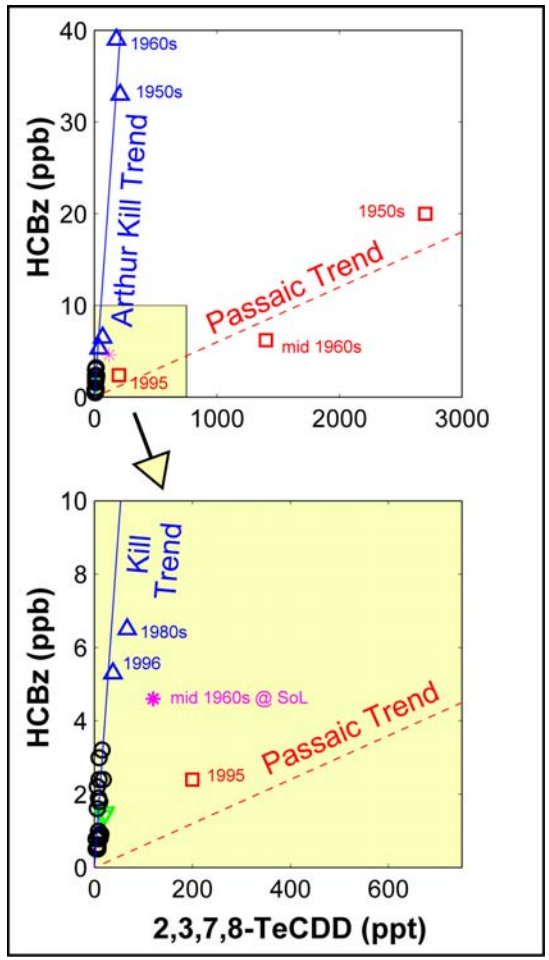


Same Source; Another Contaminant - DDT

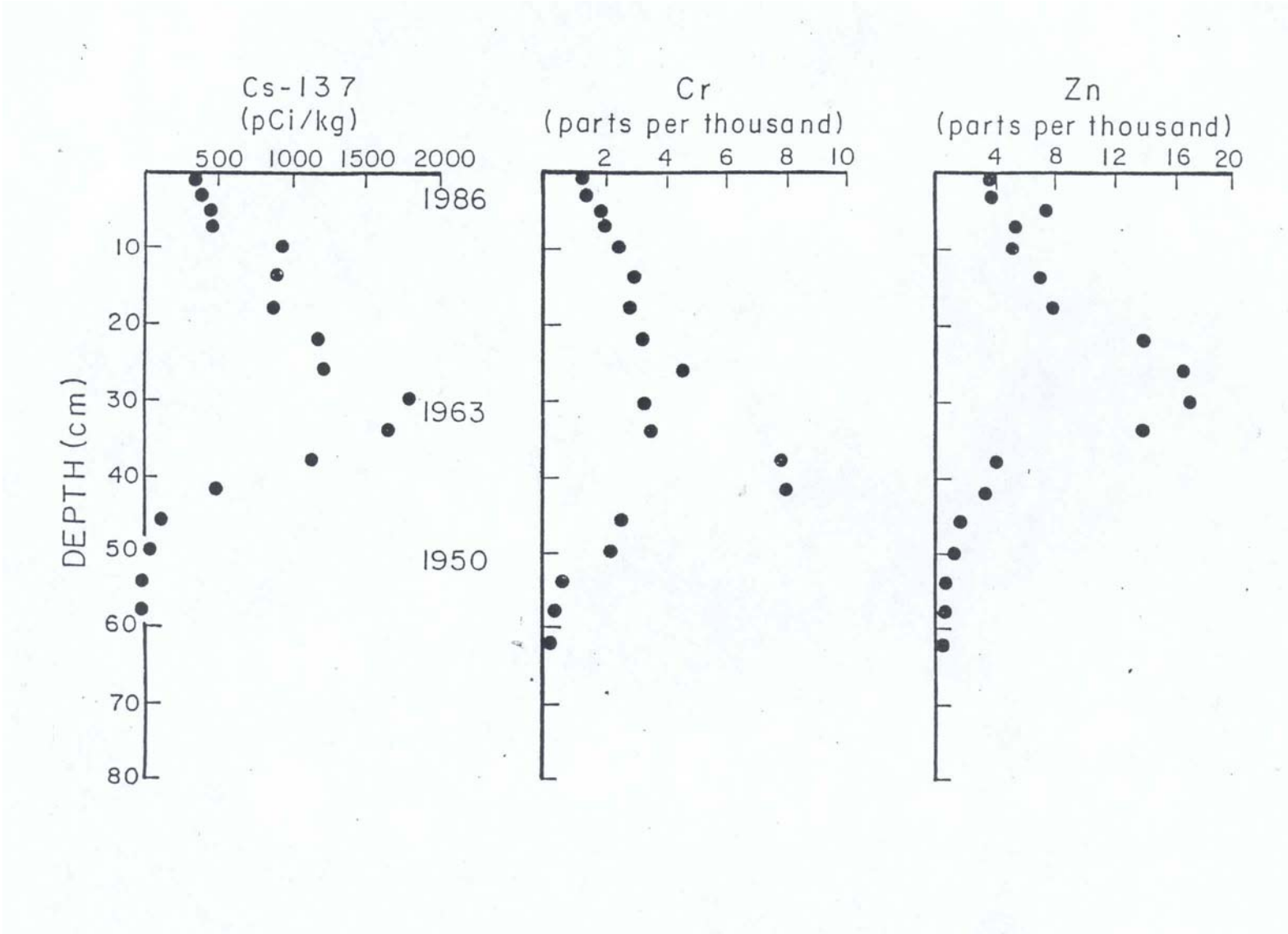


Hexachlorobenzene?

- Although produced at 80 Lister Avenue, a source near the Arthur Kill apparently dominates HCB loadings to the Harbor

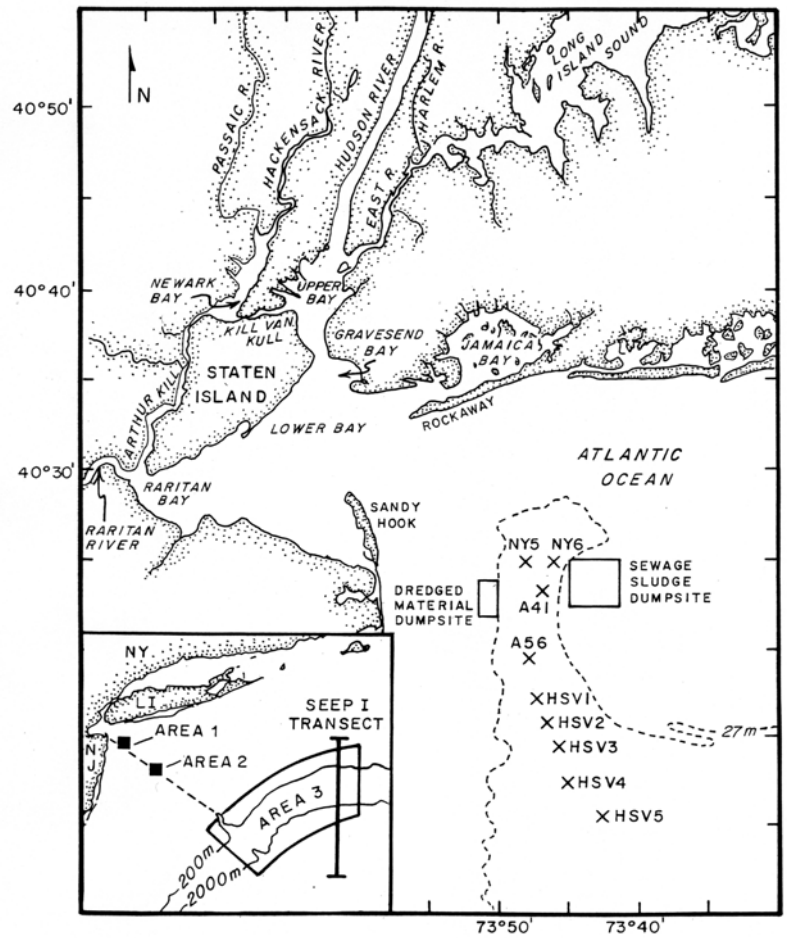


Other Sources; Other Contaminants



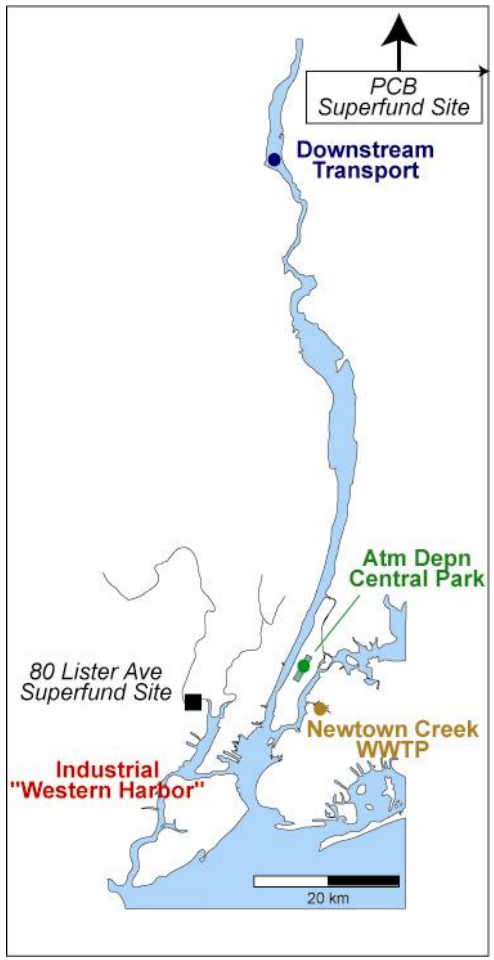
Other “distribution” of Western Harbor Contaminants

- Dredge spoil (upland)
- Offshore disposal



Other contaminant sources

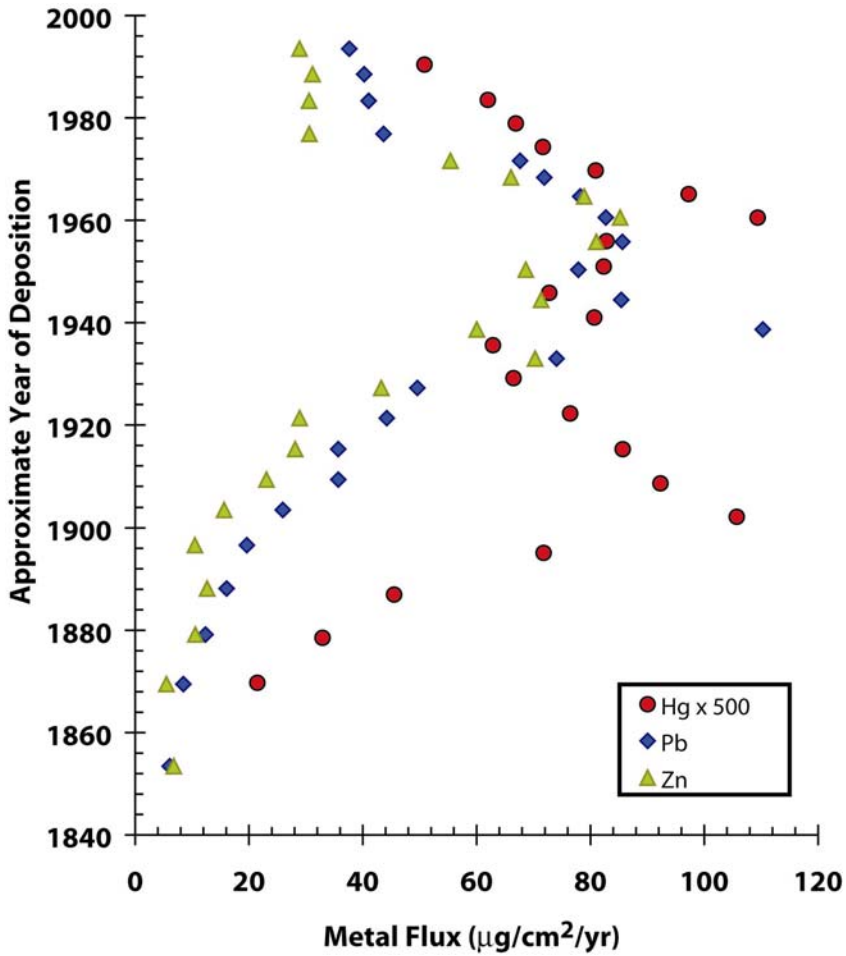
- Newtown Creek, Jamaica Bay WWTP
  - Sediment monitoring near discharge points
- Atmospheric deposition
  - Sediment cores from Central Park Lake, Prospect Park
- Local road runoff
  - Van Cortlandt Park



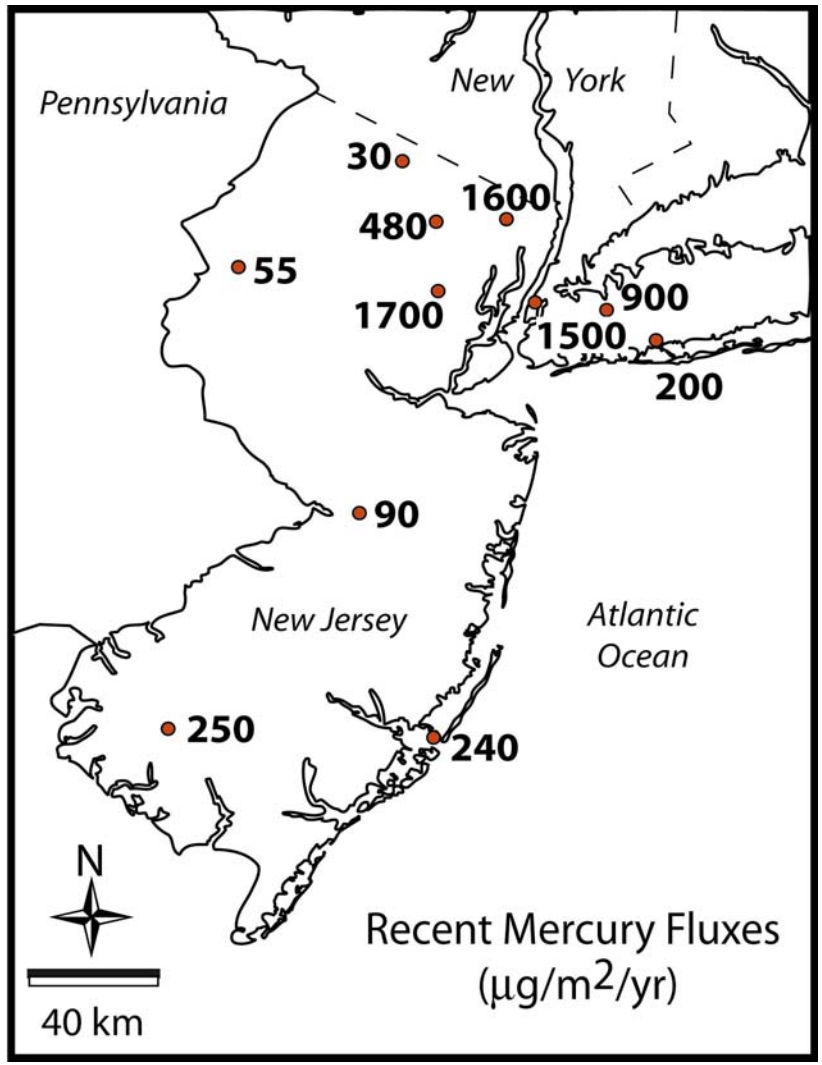
“Re-emerging” and Emerging Contaminants

- Mercury
- APEOs
- PBDEs

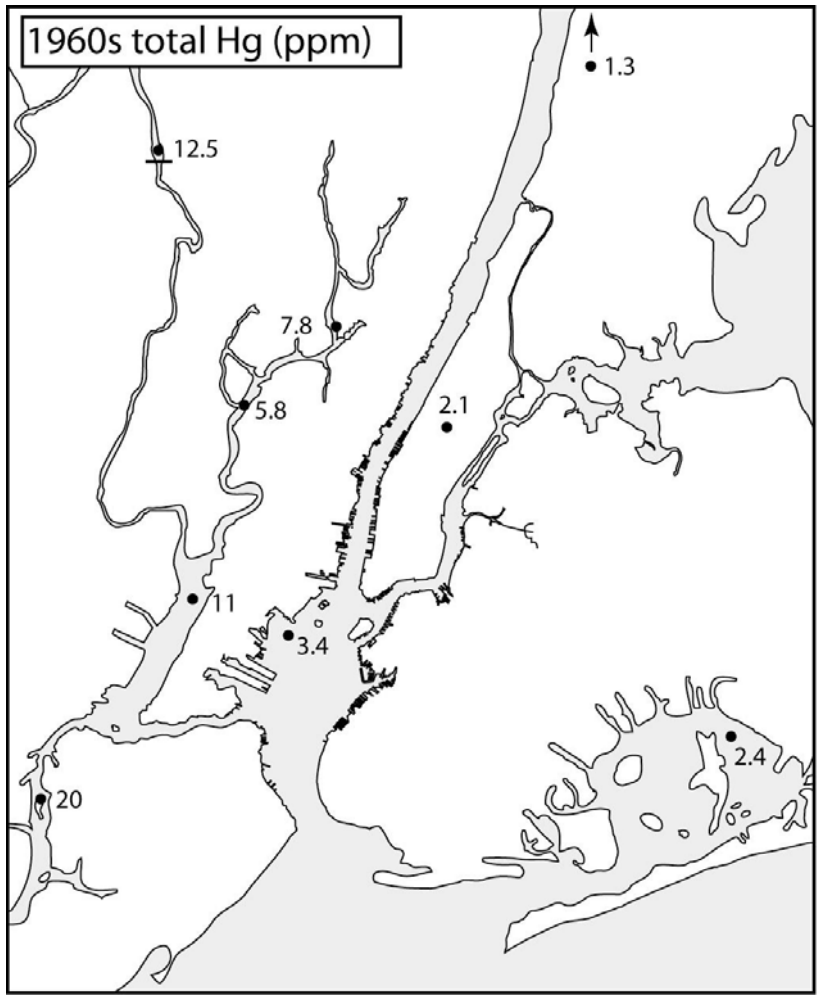
Mercury deposition in Central Park Lake

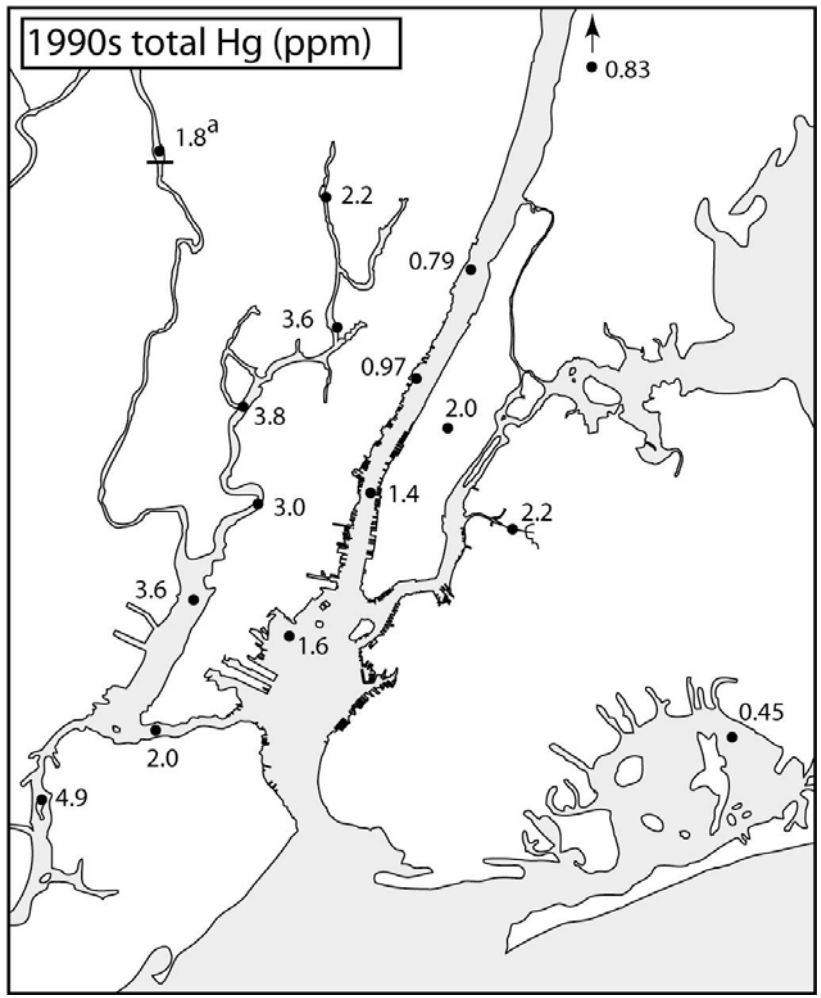


Regional Atmospheric Hg Flux

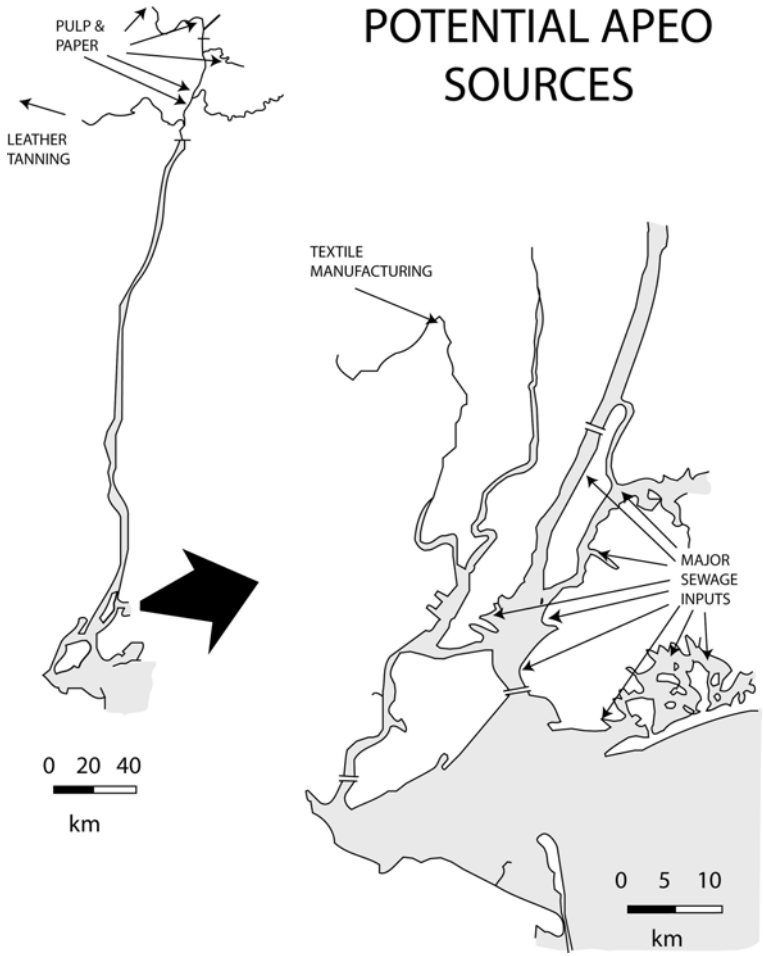


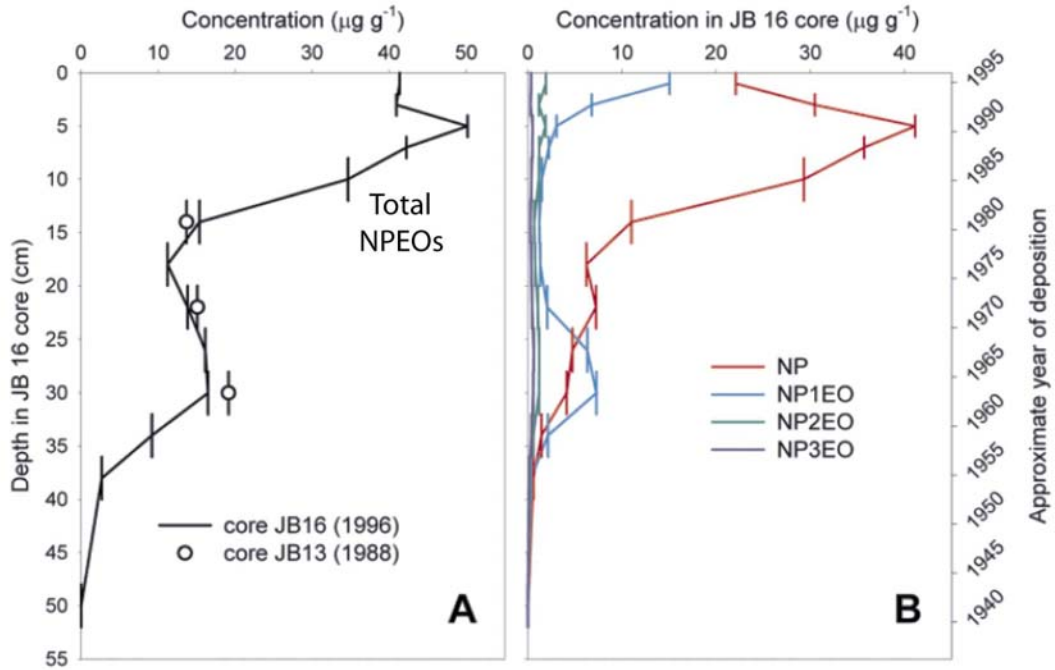
Hg flux to Harbor Sediments



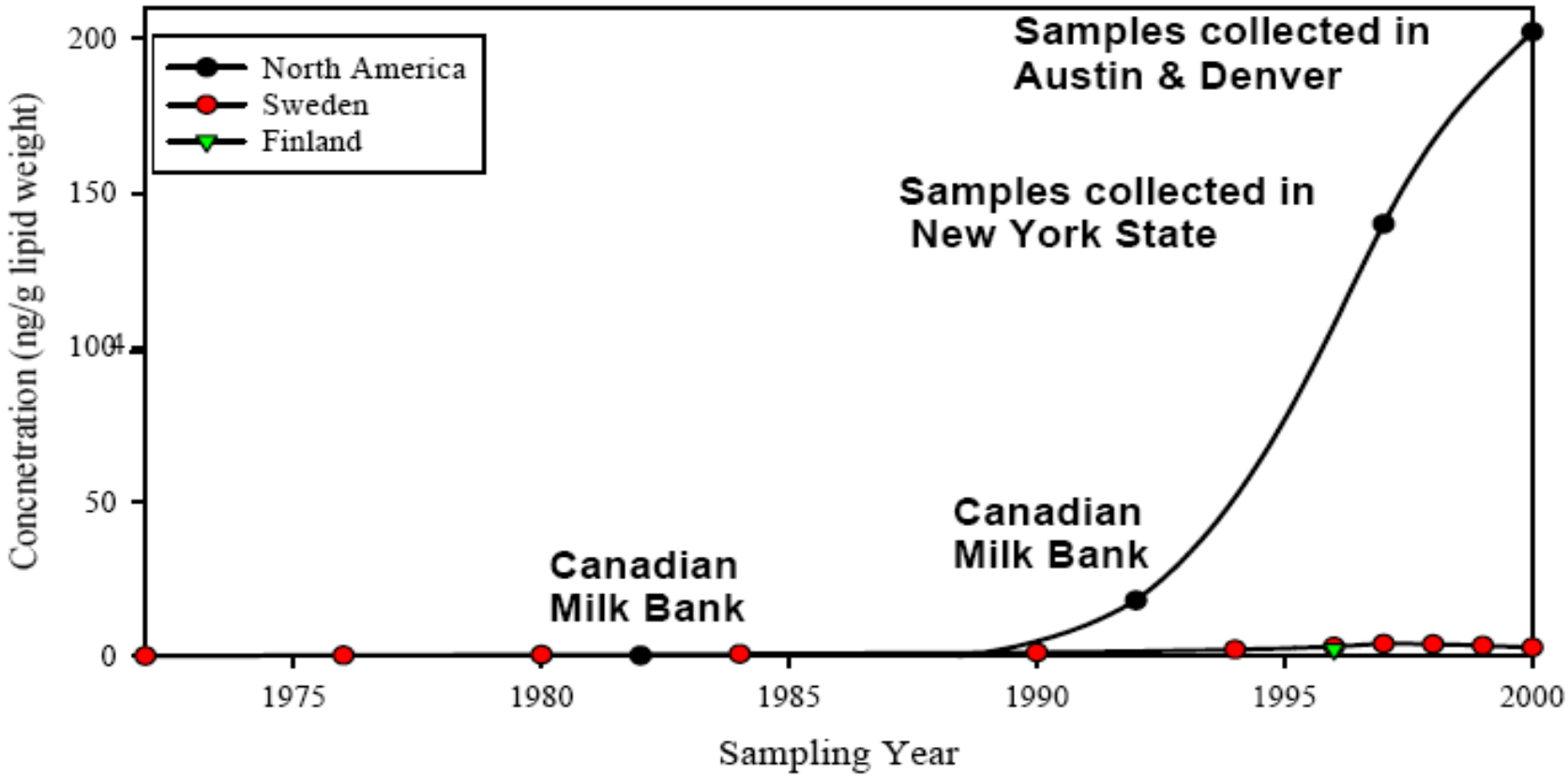


APEOs


POTENTIAL APEO SOURCES
PULP & PAPER
LEATHER TANNING
TEXTILE MANUFACTURING
MAJOR SEWAGE INPUTS
0 20 40
km
0 5 10
km

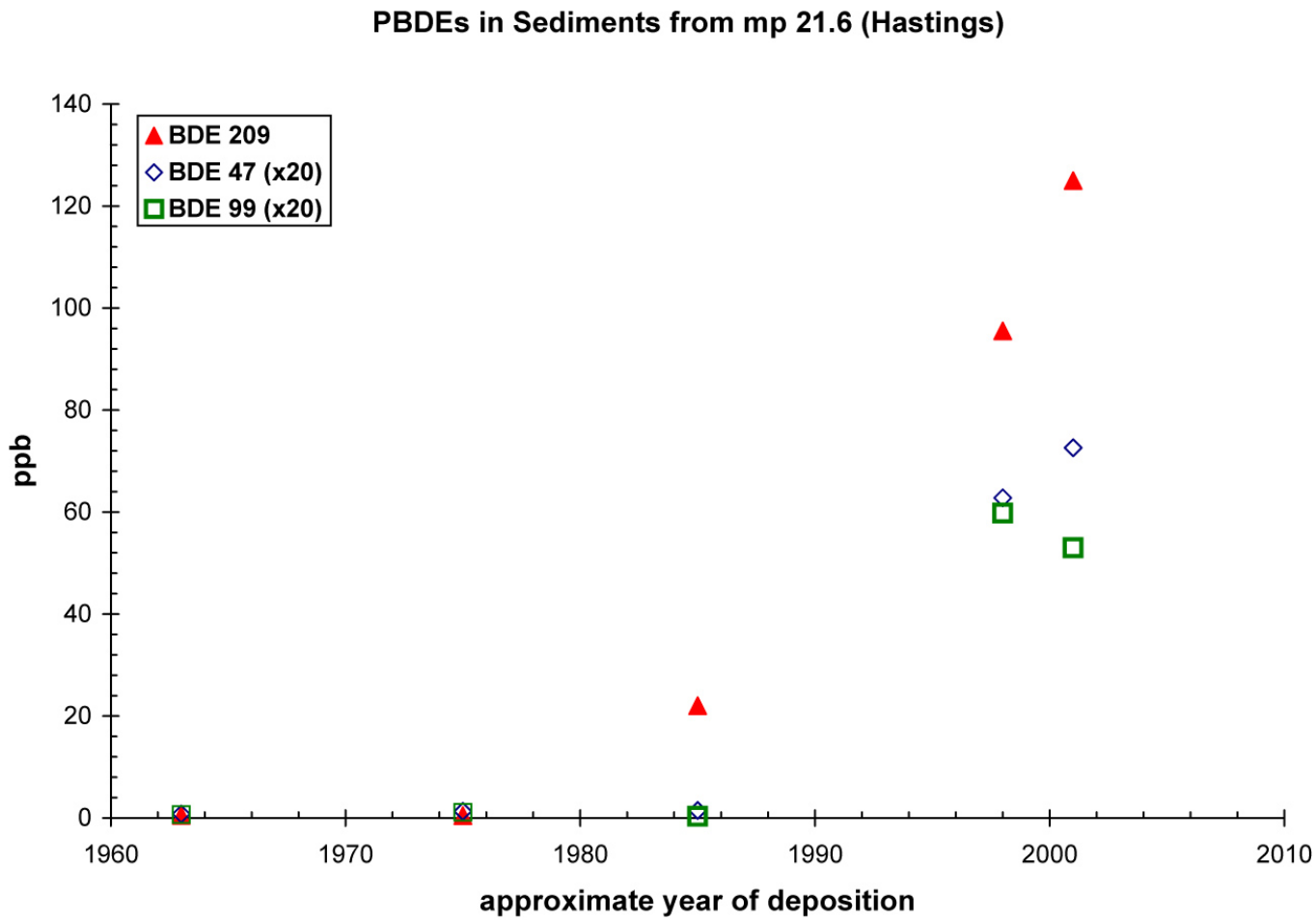

Concentration (μg g-1)
Concentration in JB 16 core (μg g-1)
Depth in JB 16 core (cm)
Approximate year of deposition
Total NPEOs
core JB16 (1996)
core JB13 (1988)
NP
NP1EO
NP2EO
NP3EO
A
B

Comparison Between Concentrations of PBDEs in Breast Milk from North America and Europe

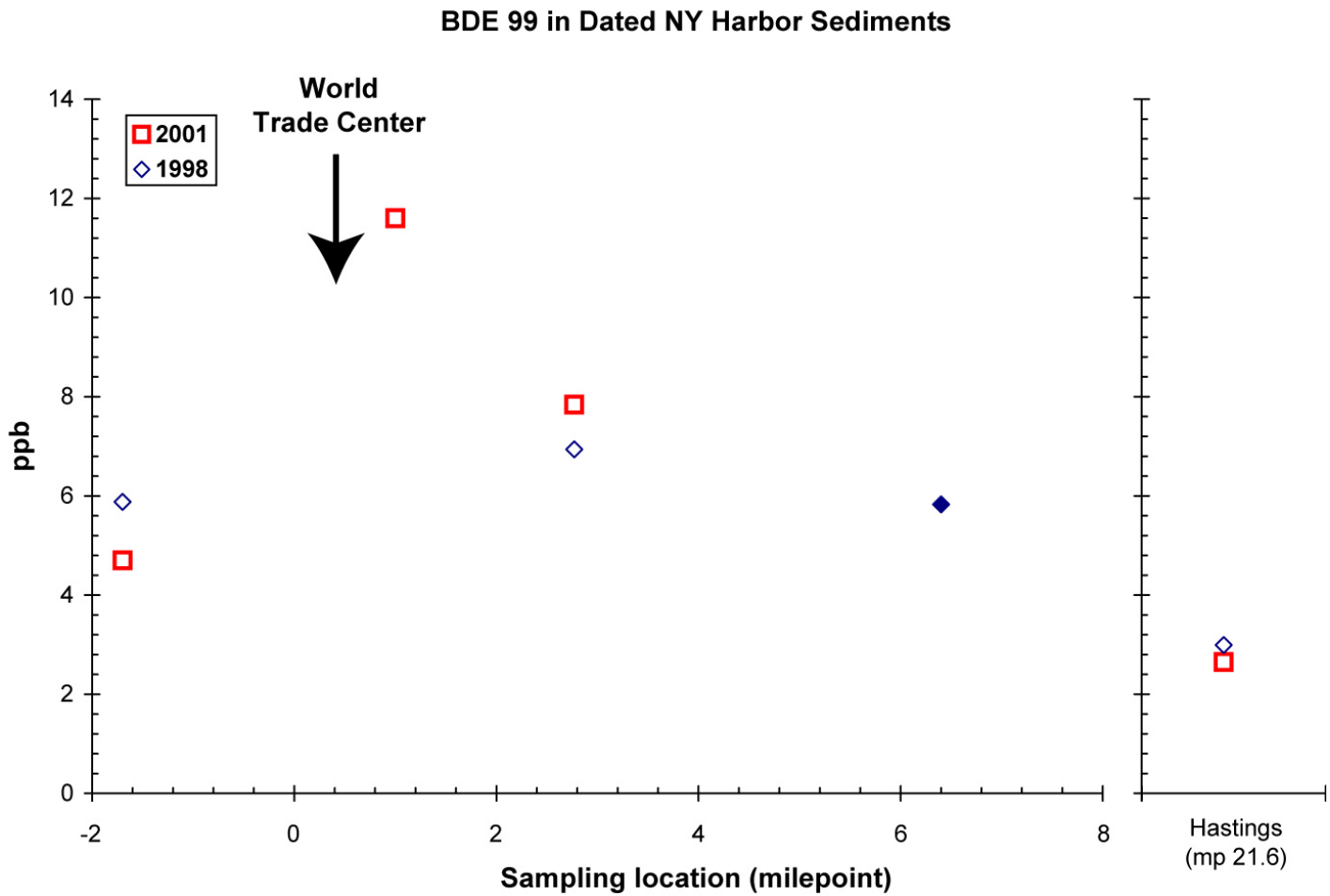


Betts, K.S., 2001. Rapidly rising PBDE levels in North America. *Environmental Science and Technology Online News, December 7, 2001.*

PBDEs in Hudson Sediments - Long term trends



The WTC influence




MIT
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